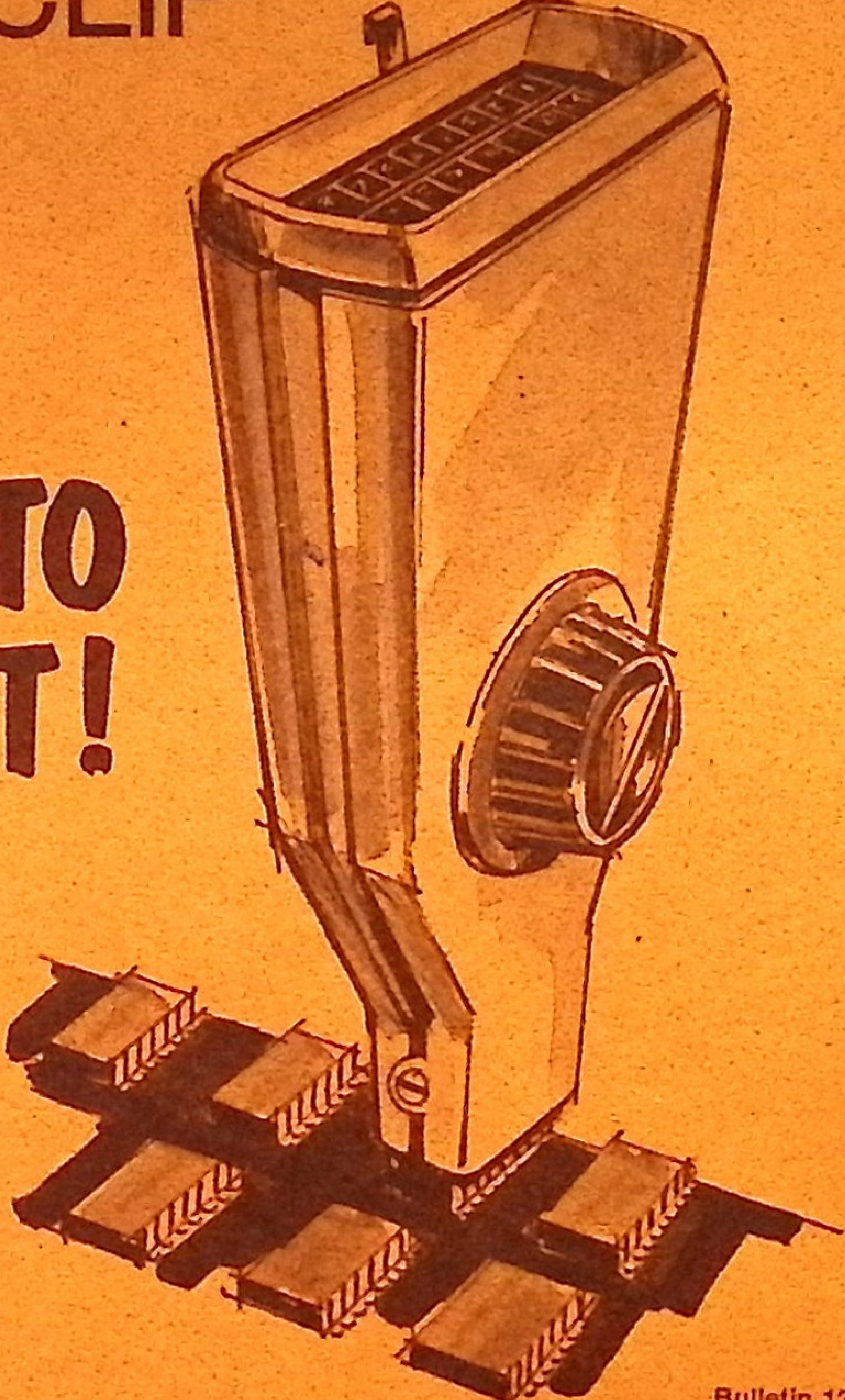
FLUKE TRENDAR

200 SERIES TESTCLIP



HOW TO USE IT!

Bulletin 133

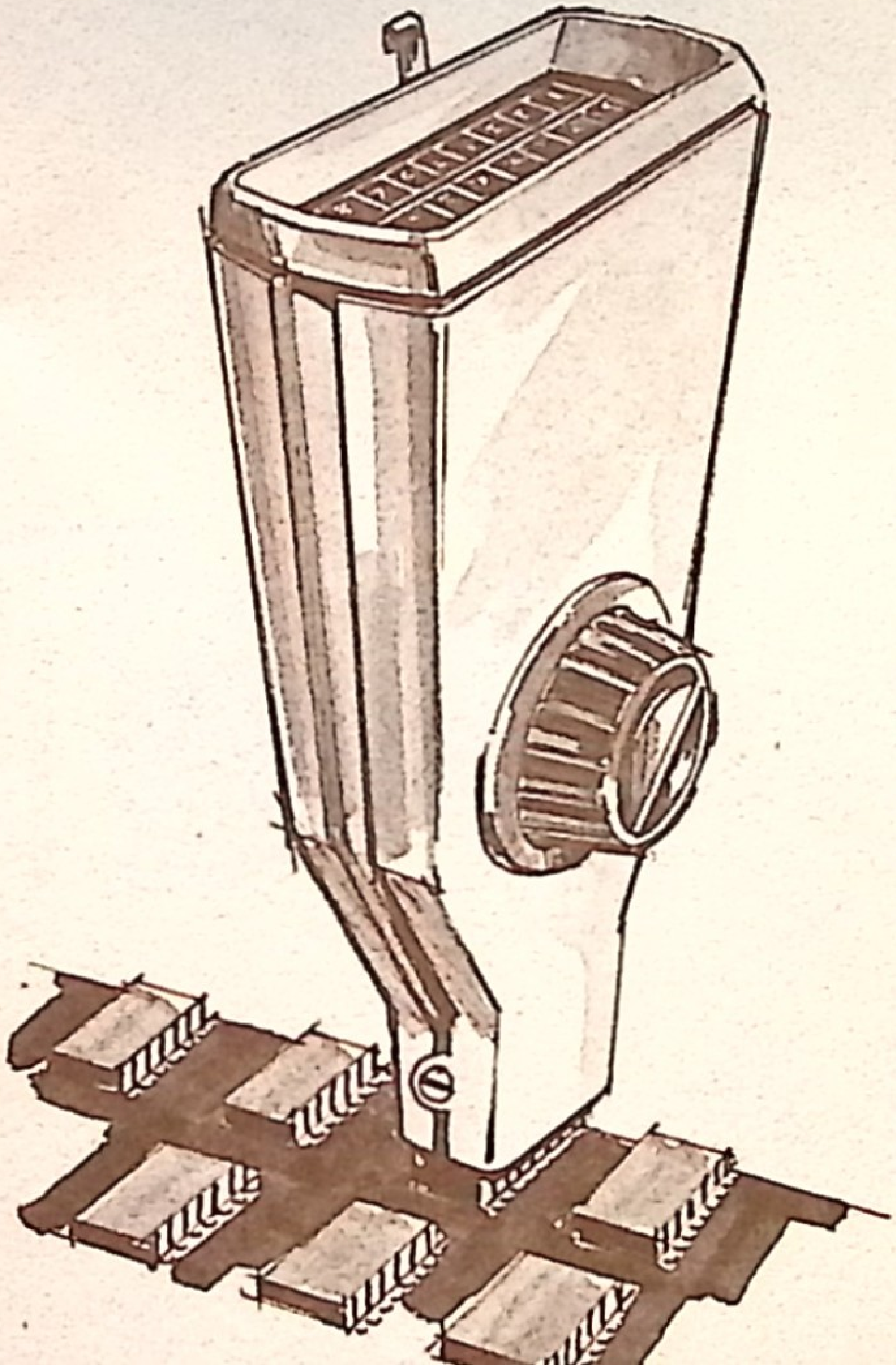
INTRODUCTION

TESTCLIP is a low-cost digital logic troubleshooting tool which will provide an effective means for fault diagnosis with highest test confidence. A few minutes with this manual will familiarize you with the technique.

The circuit in question must be activated either by the system or a board tester. The input activity must be sufficient to ensure complete truth-table toggling of the IC's. Sequential devices such as flip-flops, shift registers, counters, etc., must have proper initializing inputs.

We encourage you to quickly review this data. The result will be a significant improvement in your logic troubleshooting results.

ATTACHING THE TESTCLIP



1.

Squeeze like a clothes pin

2.

Orient to Pin 1

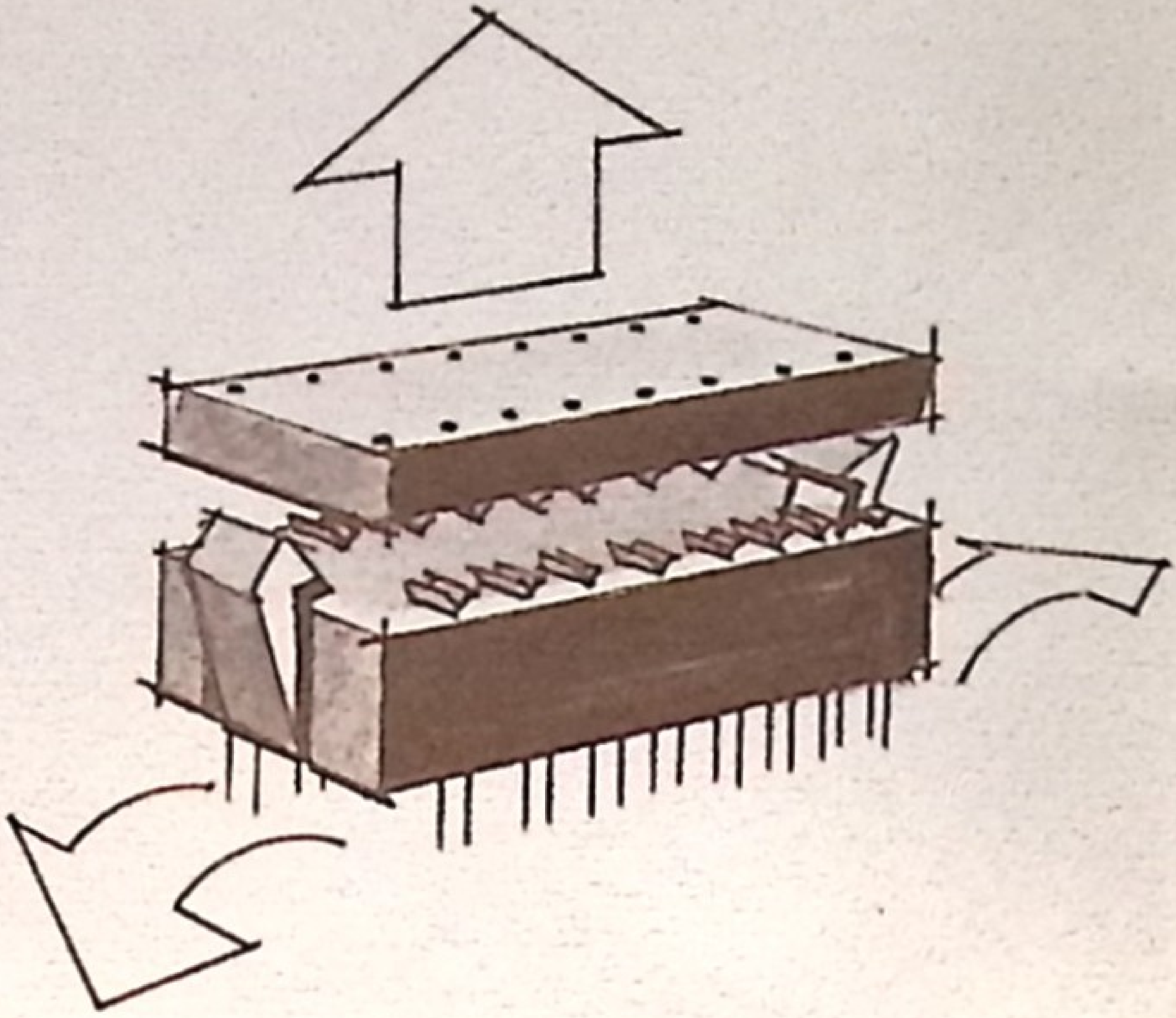
3.

Lean at 30° angle locating edge of clip to Unit Under Test (UUT).

4.

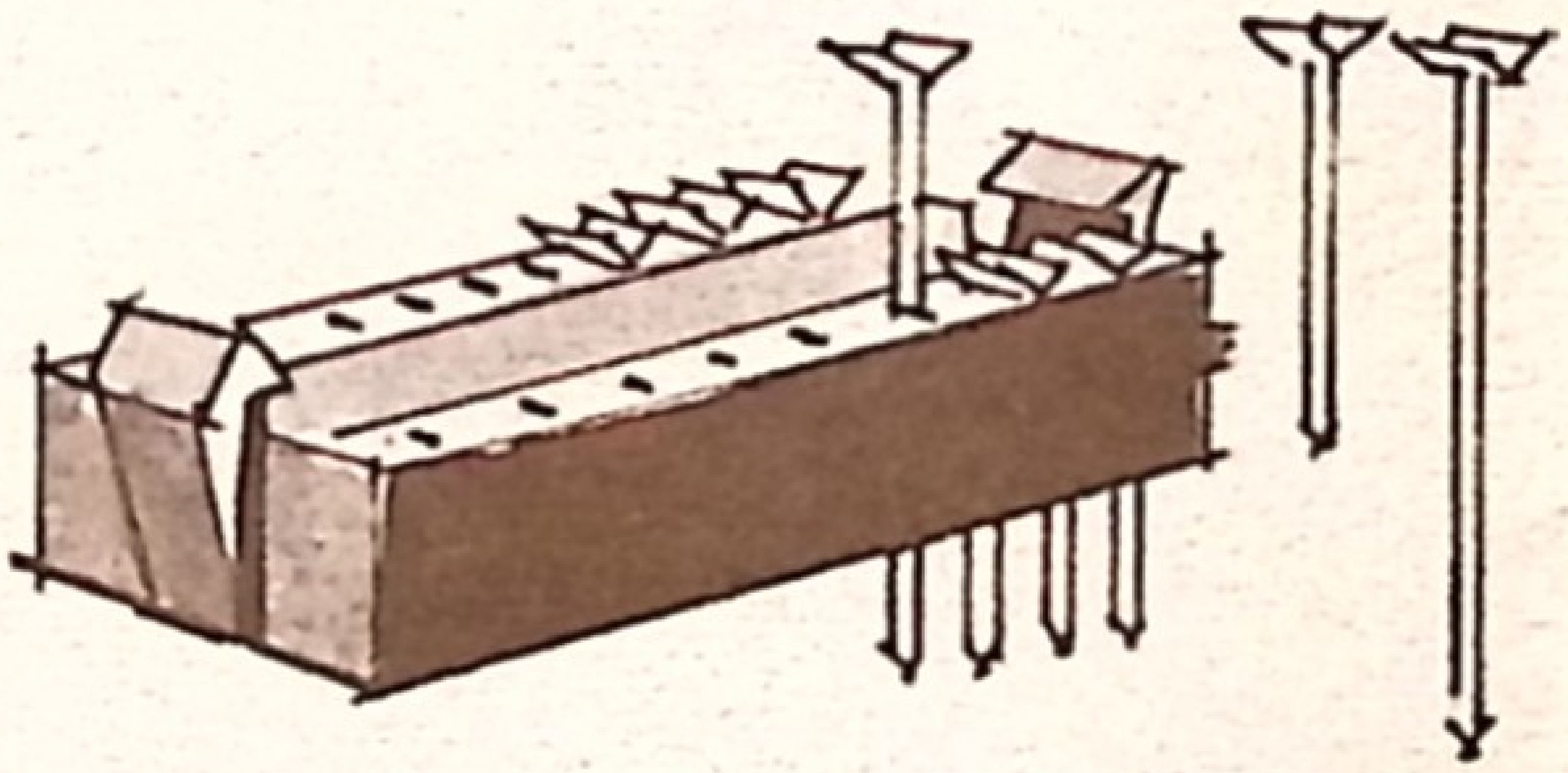
Raise to vertical until opposite edge of clip is flush with board, then release. Rocking the clip will break through any foreign material on pins. It is vital to insure good pin contact. Conformal coatings must be chemically removed.

PROGRAMING REFERENCE IC



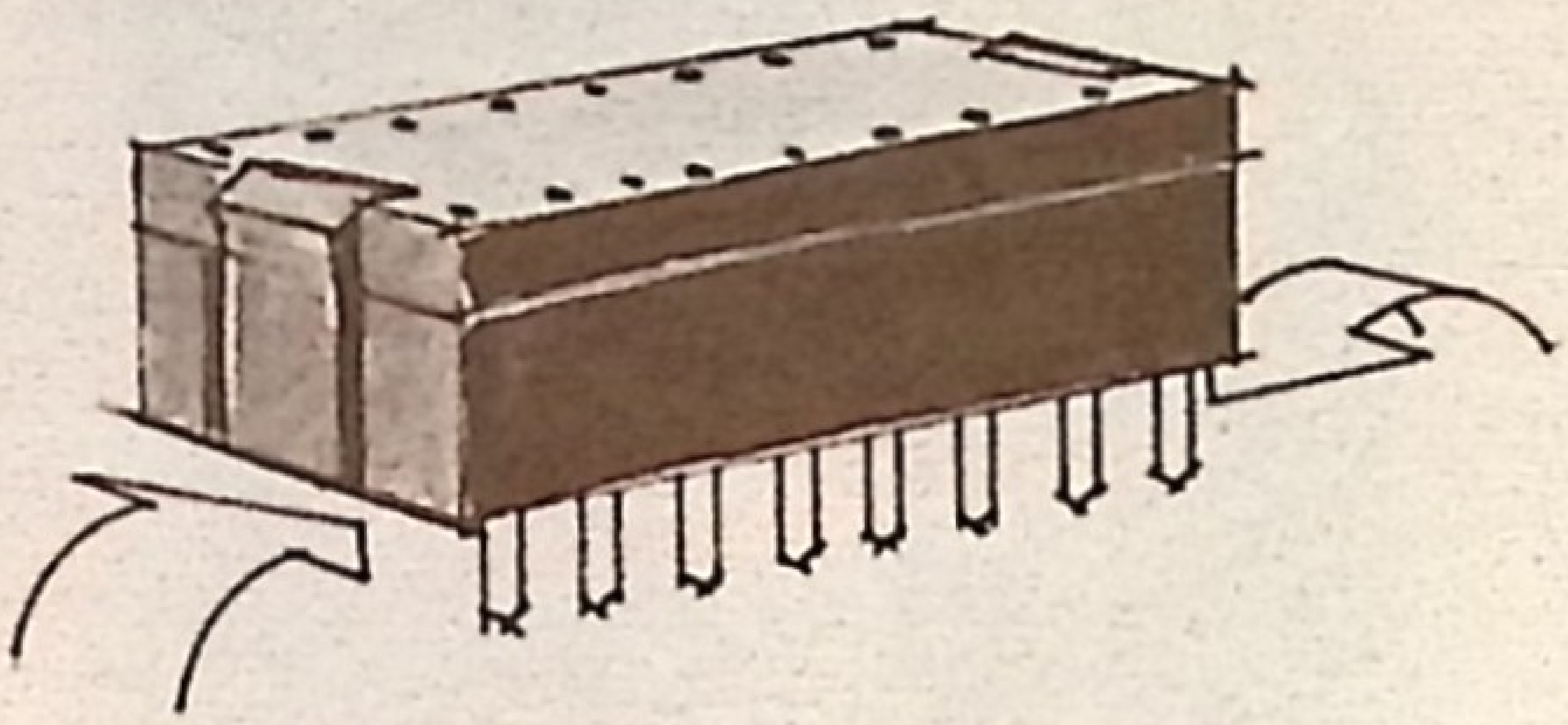
5.

Bend spring tabs outward. Do not overbend. Remove cap.



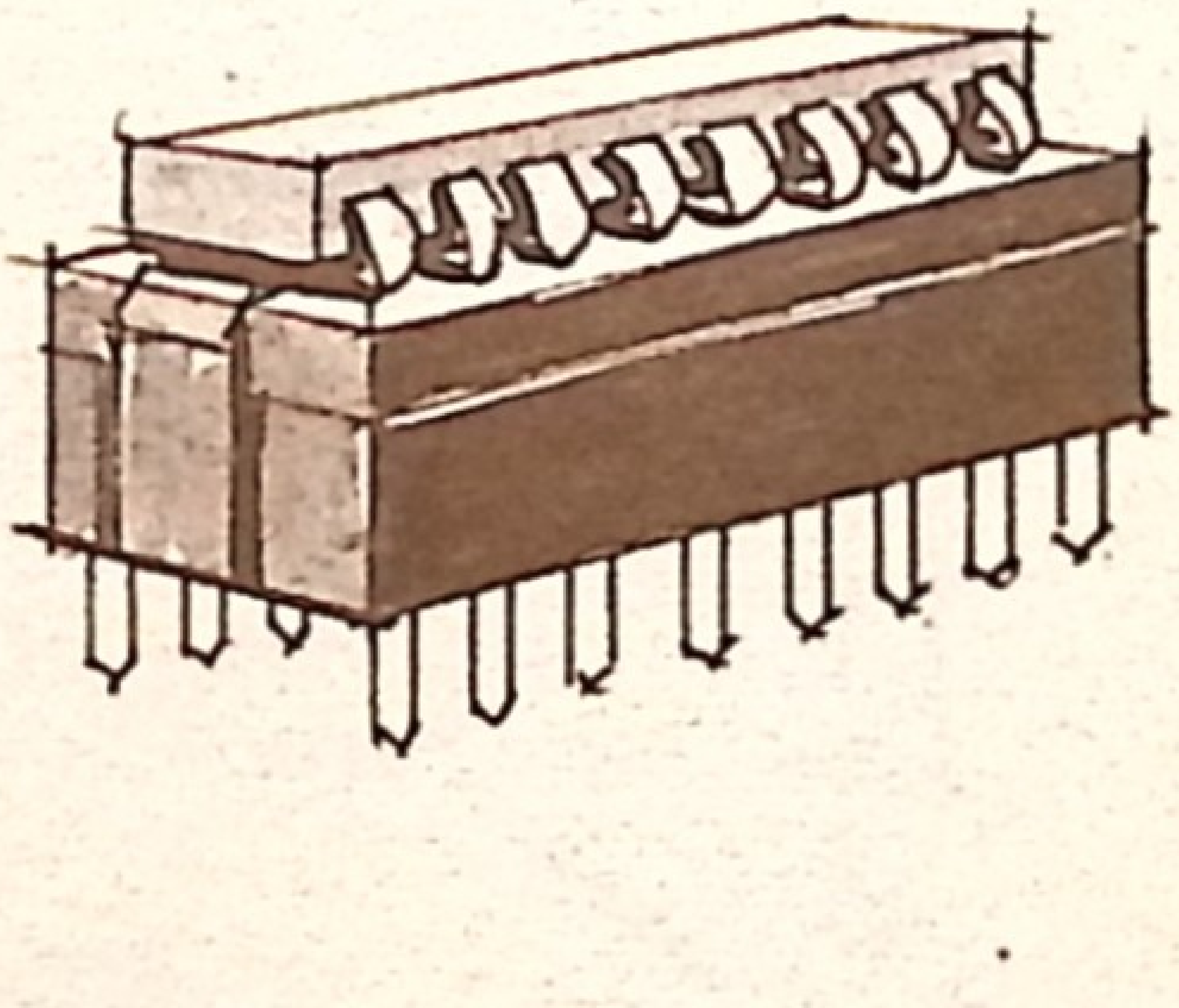
6.

Remove long pins wherever *outputs* occur. Reinsert with short pins from small box. (Never cut pins.)



7.

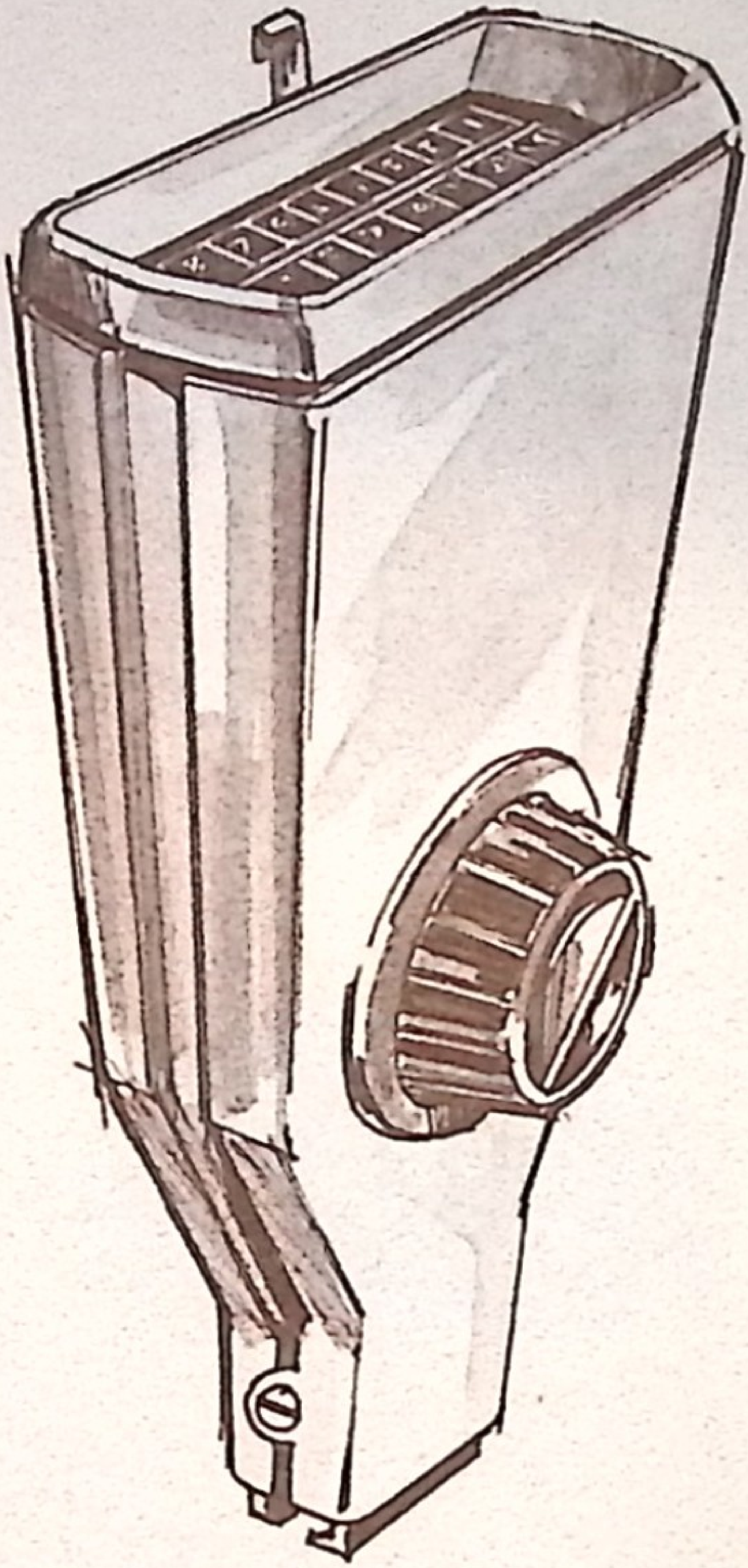
Reinstall cap, press in on tabs to lock in place. Make sure Pin 1 arrow key on cap is oriented toward Pin 1 end.



8.

Insert Reference IC keyed to Pin 1. Place in TESTCLIP box as part of Reference library. (A ¼″ Dymo label aids quick identification.) Repeat programming sockets for each IC type.

CHECK FOR TOGGLING ACTIVITY ON INPUT PINS



9.

Attach clip to first IC of suspect logic chain and monitor toggling activity.

10.

Dial Selector Switch to all input pins. (Yellow numbers apply to 14-pin IC's.)

11.

Display is at ▽ .

12.

If ▽ LED remains on, pin is high.

13.

If ▽ LED remains off, pin is low.

14.

Pulses in excess of 100ns wide are displayed as a flashing ▽ LED.

IN CIRCUIT TESTING

15.

Insert programmed Reference IC (same device type as UUT) into TESTCLIP. IC Pin 1 goes next to white dot.

16.

Attach TESTCLIP to UUT.

17.

Failures appear as lit LED's. (Yellow numbers are for 14-pin IC's.)

18.

Dial Logic Monitor switch to failed pins to determine logic state.

19.

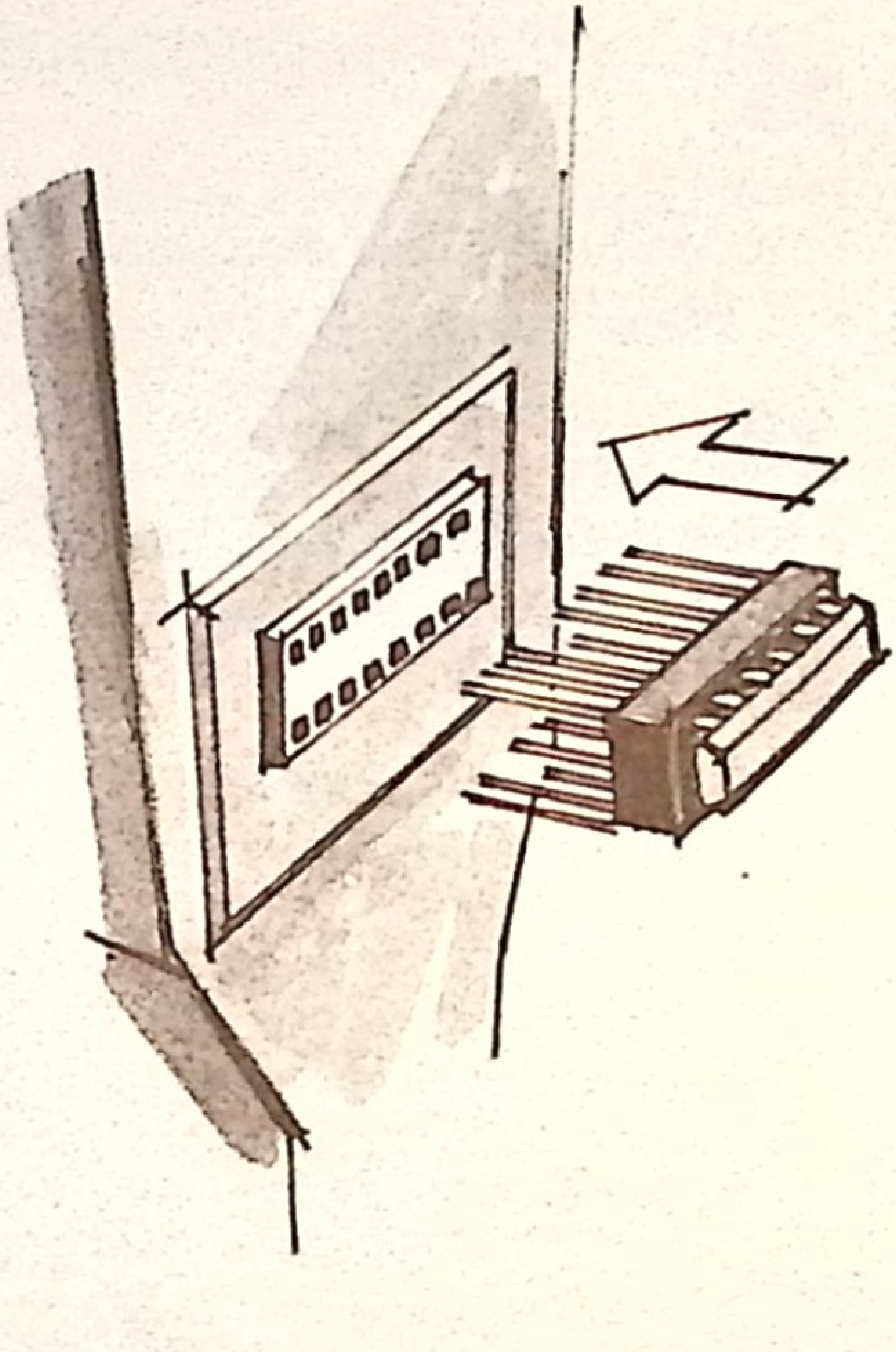
Inspect board for trace faults. If no trace faults are found and the node is stuck high: change driving IC; if node is stuck low: change driven IC.

20.

Sequential logic must receive initializing inputs for a valid test. See page 13.

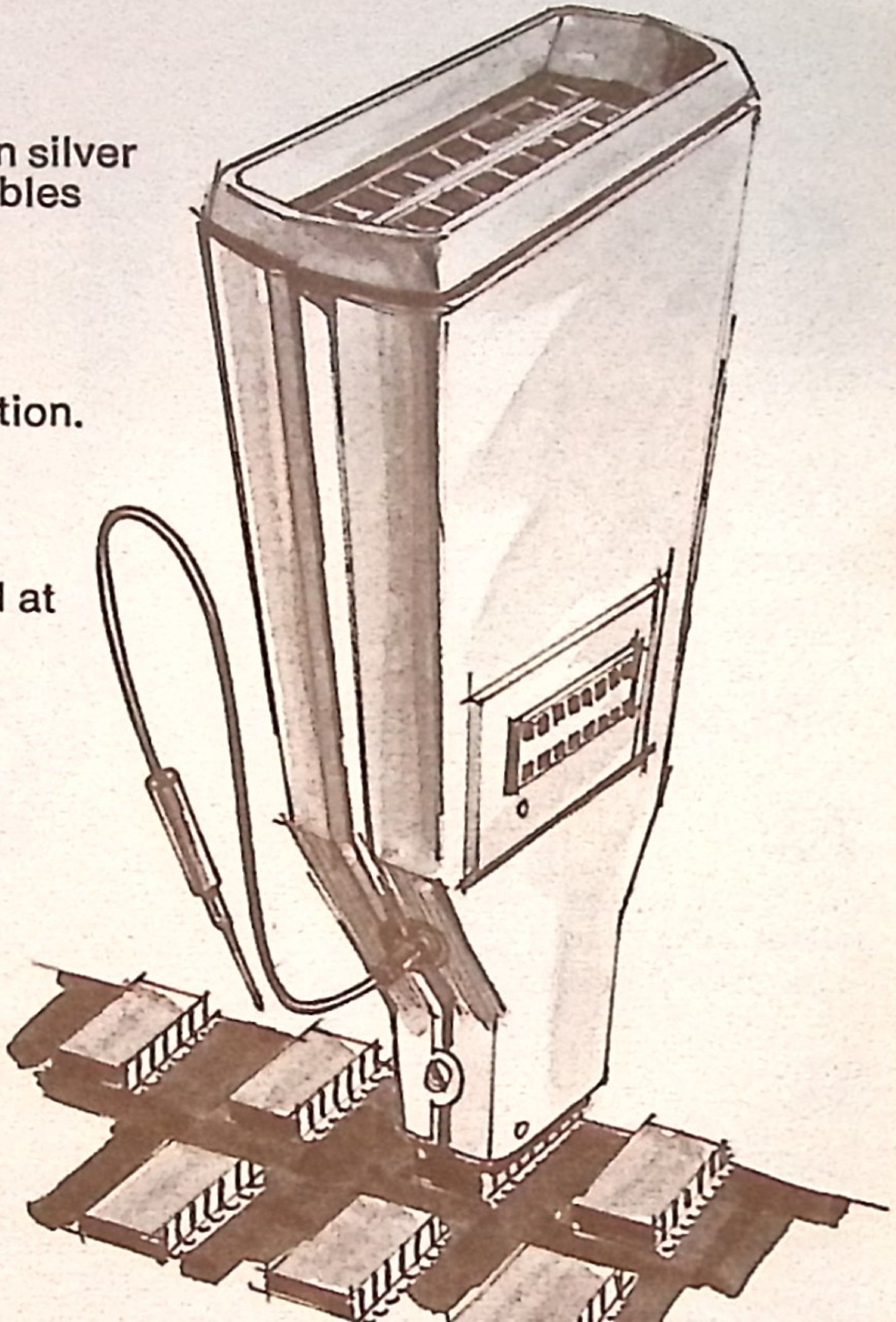
21.

Continue checking subsequent IC's in a similar manner working toward board output.



(For additional Faultrack information see page 14.)

SIGNAL TRACING WITH THE LOGIC MONITOR EXTENDER



22.

Insert Extender Probe in silver colored jack. (This disables the switch.)

23.

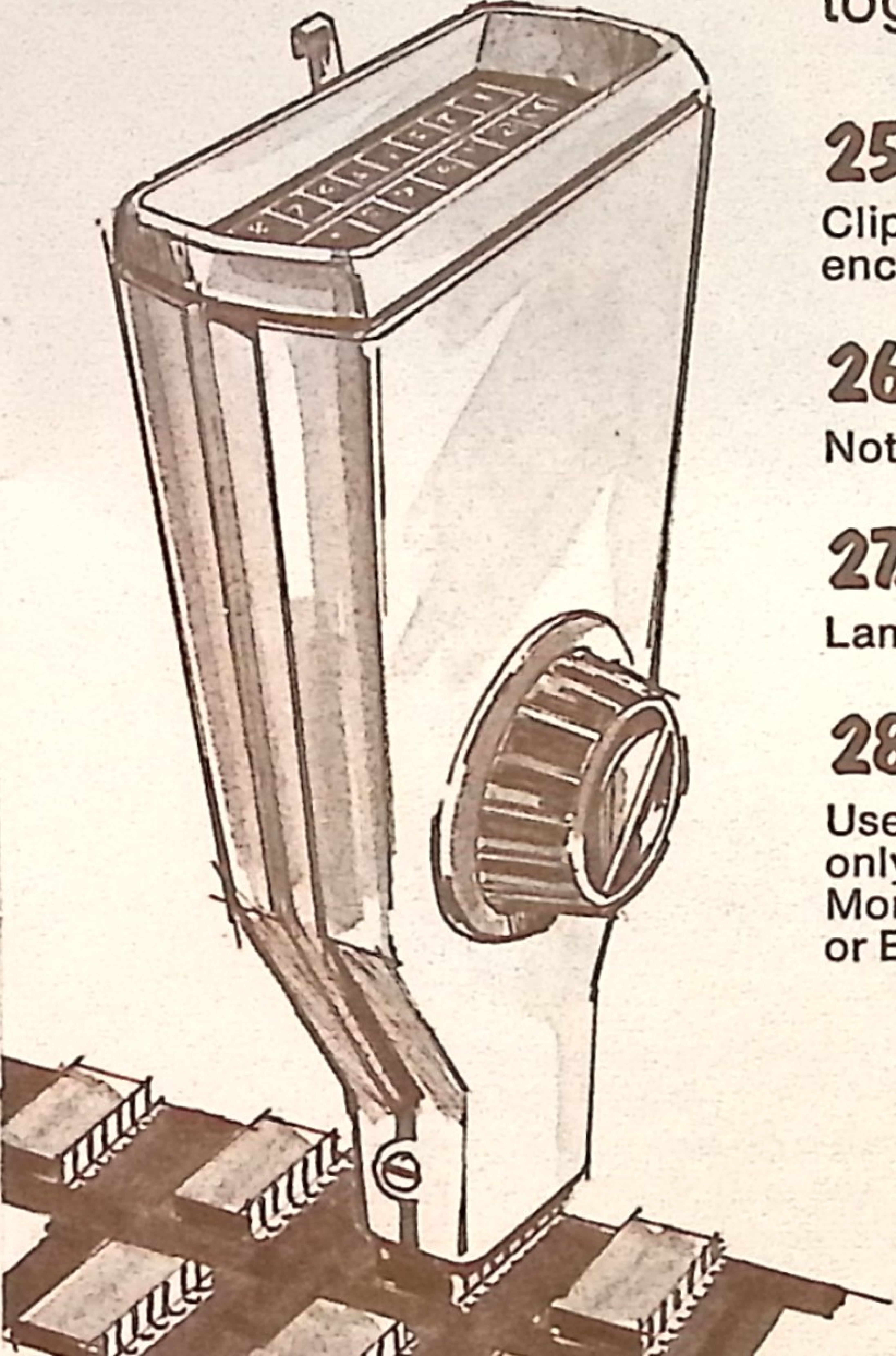
Probe the node in question.

24.

Logic level is displayed at ▽, LED on = 1.

USING TESTCLIP TO MONITOR ALL PINS

(Useful for slow toggling activity only)



25.

Clip over UUT with no reference IC plugged in.

26.

Note pin activity on active pins.

27.

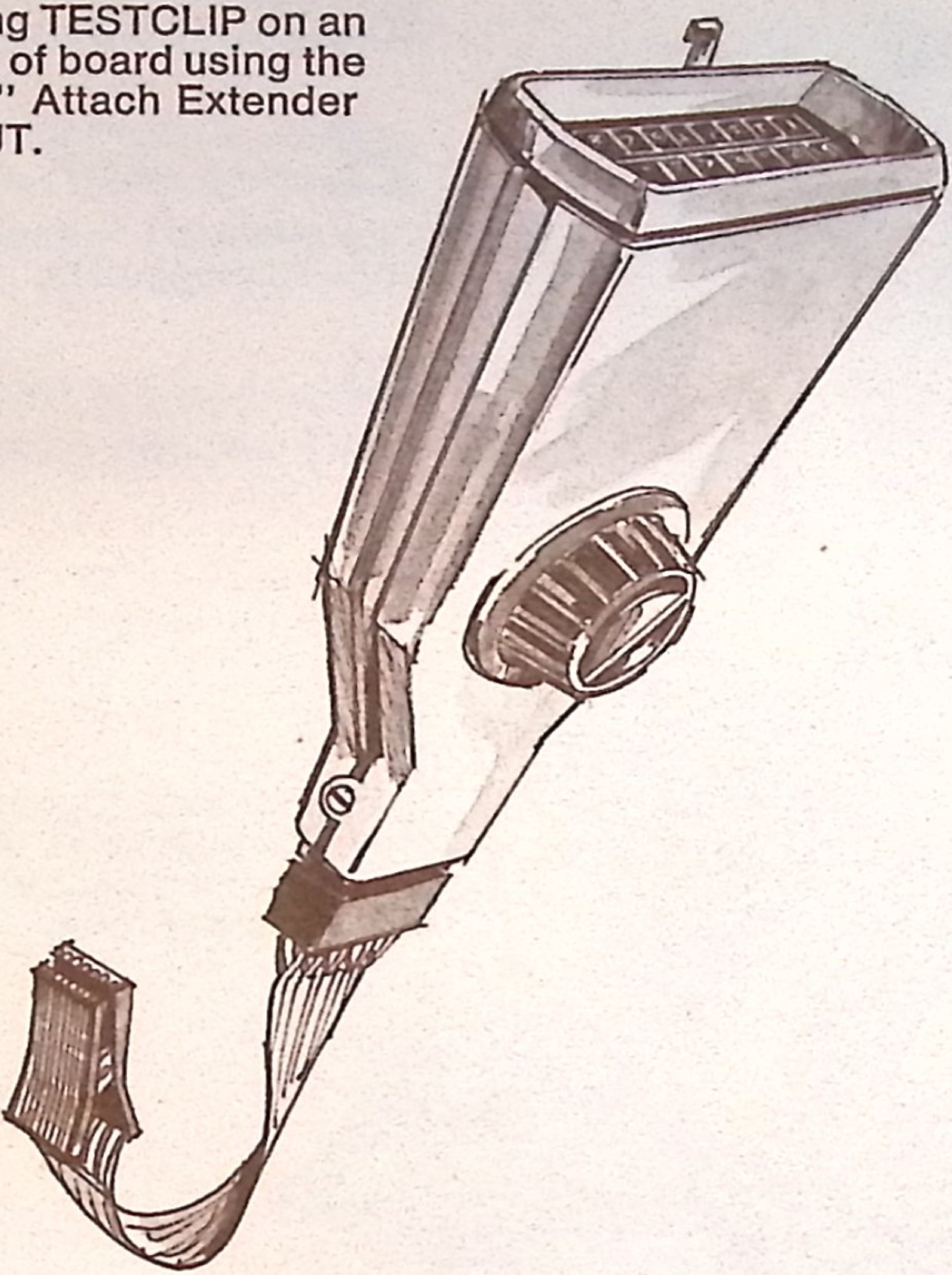
Lamps on = "0".

28.

Useful for slow toggling rates only. For high rates, use Logic Monitor and Selector Switch or Extension Probe.

USING EXTENDER CABLE

Attach TESTCLIP to Extender Cable; hang TESTCLIP on an IC or edge of board using the "skyhook." Attach Extender Clip to UUT.



HELPFUL HINTS

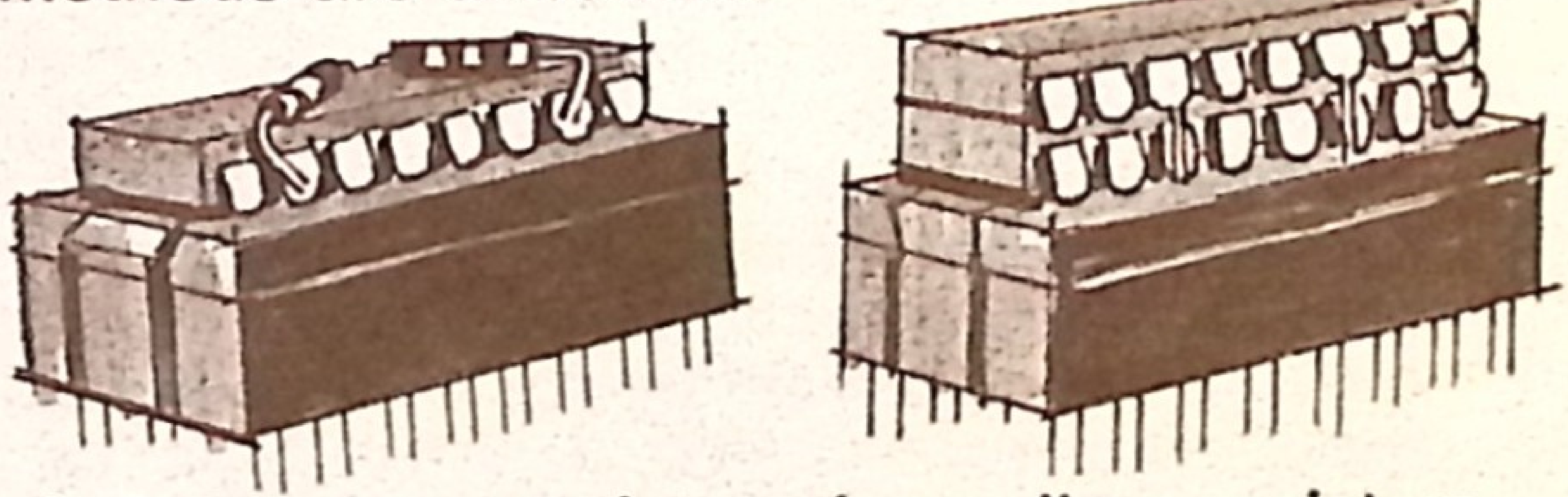
Vcc — Always measure Vcc to assure it is within operating range both for the test module and TESTCLIP. TESTCLIP will suffer damage if voltage range is exceeded.

Model		Vcc	
	T200-01		4.5-10VDC
	T200-02		4.5-5.5VDC
	T200-03*		10-15VDC*

*If supply voltage to a CMOS board drops below 10VDC after the TESTCLIP is attached, use the Auxiliary Power Supply (TC8).

High Voltage Drivers — If any output device is returned to a voltage higher than the TESTCLIP operating range, damage will occur. This includes lamp drivers.

Open Collector Devices — These devices require an external pull-up resistor in order that a "1" level is a proper level. TESTCLIP has a built-in 100,000 ohm Reference IC pull-up. If the same value as used on the UUT is necessary, two methods are available:



a) Solder appropriate value pull-up resistors between output pin(s) and Vcc.

b) Use a hybrid resistor module such as:

	Allen Bradley	Beckman
14 Pin	34A4724	899-1-R4.7K
16 Pin	36C4724	878-1-R4.7K

HELPFUL HINTS (con't.)

Testing Combinatorial Devices — Virtually all combinatorial devices except some expandable gates (such as 7450, 7453, etc.) are testable by TESTCLIP — see Table 1 for proper pin-outs.

Troubleshooting Wired-ORS — This logical configuration is used quite frequently to save logic, presenting a complex troubleshooting task. The configuration consists of several gates whose outputs are wired together performing the OR function. Any gate can control the bus, and if any one of these gates becomes defective, it can hold the entire OR bus in a static state.

There are three methods of troubleshooting the Wired-OR configuration:

1. The output pin of each device may be lifted in turn to separate it from the Wired-OR bus. The TESTCLIP can then be used in the comparison mode.
2. If the devices connected in the Wired-OR configuration are in the same package, the reference IC for the TESTCLIP can be wired in the same configuration.
3. A common troubleshooting method is to effectively disable all devices except the one under test by forcing their outputs high. The Wired-OR output will then follow only the device under test and allow use of the TESTCLIP in the comparison mode. This may be accompished by shorting one or all inputs to ground or Vcc, depending on the device. Shorts to Vcc may damage the previous driving IC's, so it may be necessary to backtrack and ground the inputs of that driving IC to disable the Wired-OR device in question.

Testing Sequential Logic — Such devices as flip-flops, counters and shift registers must be initialized to perform a valid test. Most devices are initialized by a reset pin. If the reset is not active on the UUT, failure indications in the compare mode may result due to the UUT and reference IC's being in different states. Unless simultaneously initialized by other methods, simple counters will be initialized by reset, presettable counters by a preset or reset, flip-flops by a preset, reset or clocked data. Shift registers will be initialized by a reset, a load (parallel load type) or after as many clock cycles as there are bits in the shift register.

Testing Rams—Prior to making a valid comparison, data must be written into both the UUT and reference IC's (initialization). Thus, all addresses must be exercised during writing and reading.

Testing One-Shots — Improper operation can occur if an attempt is made to parallel the UUT's external R/C network with the Reference IC. For time-outs less than 2 microseconds, an R/C network can be soldered to the Reference IC. Select the resistor and capacitor values to provide a nominal value equal to the time duration of the UUT. Short pins should be used on the reference IC for the R_{ext} and C_{ext} pins.

FAULTRACK A STEP BY STEP TROUBLESHOOTING PROCEDURE

Step 1:

Attach TESTCLIP to first IC; check for proper toggling activity.

Step 2:

Check subsequent IC's and backtrack any stuck pins to origin.

Step 3:

Test IC's systematically toward board output.

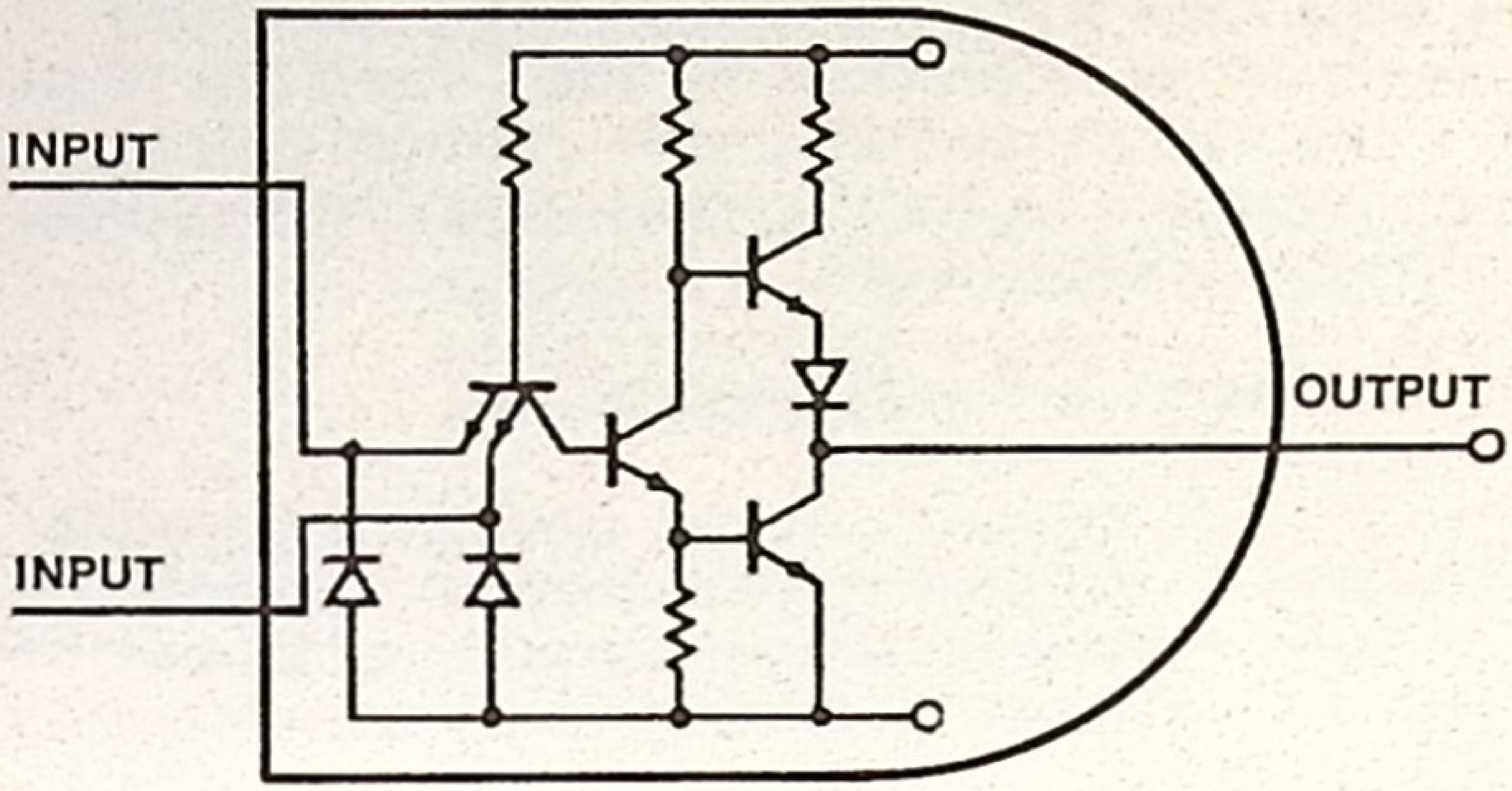
Step 4:

Perform node analysis at failed node to determine fault cause.

NODAL ANALYSIS

Step 1:

Inspect board trace for fault.



Typical Schematic 74XX Gate

Step 2:

If node is stuck low, change driven IC due to input diode short, see figure.

Step 3:

If node is stuck high, change driving IC due to upper output transistor being shorted.

For additional details on Faultrack, see Fluke Trendar brochure 122.

7400 SERIES OUTPUT PINS LIST

This table of output pins for the 7400 series of TTL IC's is divided into three sections. The first lists 14 pin DIP's in consecutive order; the second lists 16 pin DIP's in consecutive order; the third presents cross-references for the 14 and the 16 pin DIP's and lists those DIP's with identical output pin configurations, for the most commonly occurring configurations.

The comments are explained below:

OC	Open-Collector device: Reference IC may require pull-up resistor; Wire-OR configuration of IC on board may cause failure indications.
HVO	High-voltage output: Cannot test IC's with output voltage greater than Vcc.
JK	J-K Flip-Flop: If J = K = High or Low, reference IC may power up in opposite state to that IC on board and fail to compare until clear, preset, J or K input change occurs.
Tri-State	Drivers in a bus configuration will show functional failures.

(con't.)

I	Reference IC's such as counters, shift registers or memories must be subjected to input data of the IC under test for some time before comparison will occur.
Schmitt	Timing discrepancies may occur between reference IC's and IC's under test where Schmitt triggers are incorporated.
Expandable Gates	Expandable gates may be tested if their expander inputs are unused. Care must be taken to mask unused expander inputs on reference IC's and IC's under test. *Expanders* cannot be tested with the TESTCLIP.
External Timing Components	Monostable devices with external timing components may be affected by use of the TESTCLIP. For short time-outs ($<2\mu$sec) the external components may be connected to the appropriate pins on the reference IC.

7400 SERIES

7400 14 PIN DIP's

IC	Outputs	Comments
00	3, 6, 8, 11	
01	1, 4, 10, 13	OC; H Series: Outputs 3, 6, 8, 11
02	1, 4, 10, 13	
03	3, 6, 8, 11	OC
04	2, 4, 6, 8, 10, 12	
05	2, 4, 6, 8, 10, 12	OC
06	2, 4, 6, 8, 10, 12	OC, HVO
07	2, 4, 6, 8, 10, 12	OC, HVO
08	3, 6, 8, 11	
09	3, 6, 8, 11	OC
10, 11	6, 8, 12	
12	6, 8, 12	OC
13	6, 8	Schmitt
14	2, 4, 6, 8, 10, 12	Schmitt
15	6, 8, 12	OC
16, 17	2, 4, 6, 8, 10, 12	OC, HVO
20, 21	6, 8	
22	6, 8	OC
25	6, 8	
26	3, 6, 8, 11	OC, HVO
27	6, 8, 12	
28	1, 4, 10, 13	
30	8	
32	3, 6, 8, 11	
33	1, 4, 10, 13	OC
37	3, 6, 8, 11	
38	3, 6, 8, 11	OC
40	6, 8	
49	6, 8, 9, 10, 11, 12, 13	

14 PIN DIP's

IC	Outputs	Comments
50	6, 8	Pins 11, 12 expander inputs
51	6, 8	No external connection pins 11, 12
52	8	Pin 9 expander input
53	8	Pins 11, 12 expander inputs
54	8	No external connection pins 11, 12; L Series: Output 6
55	8	Pins 5, 9 expander inputs; L Series: Output 8; Pins 5, 6, 9 are unused
64	8	
65	8	OC
70, 71, 72	6, 8	JK
73	8, 9, 12, 13	JK
74	5, 6, 8, 9	
77	8, 9, 13, 14	JK
78	2, 3, 5, 6	L Series: Outputs 8, 9, 12, 13
80	4, 5, 6	
81	11, 12	Requires loading circuit
82	1, 10, 12	
86	3, 6, 8, 11	L Series: Outputs 3, 4, 10, 11
87	3, 6, 9, 12	
90, 92	8, 9, 11, 12	I
91	13, 14	
93	8, 9, 11, 12	I; L Series: Outputs 9, 10, 12, 13
95	10, 11, 12, 13	I; L Series: Outputs 9, 10, 12, 13
101, 102	6, 8	JK
103	8, 9, 12, 13	JK
107, 108	2, 3, 5, 6	JK

14 PIN DIP's

IC	Outputs	Comments
110	6, 8	JK
113, 114	5, 6, 8, 9	JK
120	6, 7, 9, 10	
121	1, 6	Schmitt; External C and R
122	6, 8	External C, R
125, 126	3, 6, 8, 11	Tri-State
128	1, 4, 10, 13	50Ω Line Driver
132	3, 6, 8, 11	Schmitt
136	3, 6, 8, 11	OC
140	6, 8	50Ω Line Driver
164	3, 4, 5, 6, 10, 11, 12, 13	I
176, 177	2, 5, 9, 12	I
178	4, 6, 8, 10	
180	5, 6	
183	5, 6, 8, 10	
196, 197	2, 5, 9, 12	I
260	5, 6	
266	3, 4, 10, 11	OC
278	5, 6, 8, 9, 10	
280	5, 6	
290, 293	4, 5, 8, 9	I
295	10, 11, 12, 13	Tri-State; I

7400 16 PIN DIP's

IC	Outputs	Comments
23	7, 9	Pins 14, 15 expander inputs
42, 43, 44	1, 2, 3, 4, 5, 6, 7, 9, 10, 11	
45	1, 2, 3, 4, 5, 6, 7, 9, 10, 11	OC, HVO
46, 47	9, 10, 11, 12, 13, 14, 15	OC, HVO; Pin 4 may be input or output
48	9, 10, 11, 12, 13, 14, 15	Pin 4 may be input or output

16 PIN DIP's

IC	Outputs	Comments
75	1, 8, 9, 10, 11, 14, 15, 16	
76	10, 11, 14, 15	JK
83	2, 6, 9, 14, 15	
84	13, 14	Requires loading circuit
85	5, 6, 7	L Series: Outputs 3, 12, 13
88	1, 2, 3, 4, 5, 6, 7, 9	
89	5, 7, 9, 11	OC; I
94	9	I
96	10, 11, 13, 14, 15	I
97	5, 6, 7	
98	11, 13, 14, 15	I
99	10, 11, 12, 14, 15	I
106	10, 11, 14, 15	JK
109, 111	6, 7, 9, 10	JK
112	5, 6, 7, 9	JK
123	4, 5, 12, 13	External C and R
133	9	
134	9	Tri-State
135	3, 7, 9, 13	
138	7, 9, 10, 11, 12, 13, 14, 15	
139	4, 5, 6, 7, 9, 10, 11, 12	
141	1, 2, 8, 9, 10, 11, 13, 14, 15, 16	OC, HVO
142	2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 14	Nixie Drivers
145	1, 2, 3, 4, 5, 6, 7, 9, 10, 11	OC, HVO
147	6, 7, 9, 14	
148	6, 7, 9, 14, 15	
151	5, 6	
153	7, 9	
155	4, 5, 6, 7, 9, 10, 11, 12	
156	4, 5, 6, 7, 9, 10, 11, 12	OC
157, 158	4, 7, 9, 12	
160, 161, 162, 163	11, 12, 13, 14, 15	I
165	7, 9	I

16 PIN DIP's

IC	Outputs	Comments
166	13	I
167	5, 6, 7	
170	6, 7, 9, 10	OC
173	3, 4, 5, 6	
174	2, 5, 7, 10, 12, 15	
175	2, 3, 6, 7, 10, 11, 14, 15	
179	5, 7, 9, 11, 12	
182	7, 9, 10, 11, 12	
184, 185	1, 2, 3, 4, 5, 6, 7, 9	OC
187	9, 10, 11, 12	OC
188	1, 2, 3, 4, 5, 6, 7, 9	OC; Memory must be programmed
190, 191, 192, 193	2, 3, 6, 7, 12, 13	I
194	12, 13, 14, 15	I
195	11, 12, 13, 14, 15	I
200	6	Tri-State
206	6	Tri-State
251	5, 6	Tri-State
253	7, 9	Tri-State
257, 258	4, 7, 9, 12	Tri-State
279	4, 7, 9, 13	
283	1, 4, 9, 10, 13	
284, 285	9, 10, 11, 12	OC
298	12, 13, 14, 15	

COMMON OUTPUT CONFIGURATIONS

14 PIN DIP's

2, 3, 5, 6	5, 6	8, 9, 11, 12	5, 6, 8, 9
7478	74180	7490	74113
74107	74260	7492	74114
74108	74280	7493	

14 PIN DIP's

3, 6, 8, 11

7400
7403
7408
7409
7426
7432
7437
7438
7486
74125
74126
74132
74136

10, 11, 12, 13

7495
74295

2, 4, 6, 8, 10, 12

7404
7405
7406
7407
7414
7416
7417

8, 9, 12, 13

7473
74103

8

7430
7462
7464
7465

6, 8

7413
7420
7421
7422
7425
7440
7470
7471
7472
74101
74102
74110
74140

4, 5, 8, 9

74290
74293

1, 4, 10, 13

7401
7402
7428
7433
74128

6, 8, 12

7410
7411
7412
7415
7427

16 PIN DIP's

9, 10, 11, 12, 13, 14, 15

7446
7447
7448

12, 13, 14, 15

74194
74298

6, 7, 9, 10

74109
74111
74170

9, 10, 11, 12

74187
74284
74285

10, 11, 14, 15

7476
74106

9

7494
74133
74134

5, 6, 7

7485
7497
74167

7, 9

74153
74165
74253

4, 7, 9, 12

74157
74158
74257
74258

1, 2, 3, 4, 5, 6, 7, 9

7488
74184
74185
74188

1, 2, 3, 4, 5, 6, 7, 9, 10, 11

7442
7443
7444
7445
74145

5, 6

74151
74251

FLUKE TRENDAR
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